

REMARKS

This is in response to the Office Action dated March 18, 2002. Applicant appreciates the thorough examination reflected in the Office Action dated March 18, 2002. Applicant amends Claims 2, 3, 5, 6, and 8 to better clarify aspects of the claimed invention. Applicant amends Claim 11 to correct a translation error. Applicant rewrites Claims 4, 8, 9 and 10 in independent form. Applicant cancels Claims 1 and 6 without prejudice. Applicants also add new Claims 12-16 by this Amendment. Pursuant to this Amendment, Claims 2-5 and 7-16 are pending. Reexamination and reconsideration of the Application, as amended, are respectfully requested.

Objection to the Drawings

The drawings were objected to under 37 C.F.R. 1.83(a), since the drawings allegedly did not show "the convex shape of the optical receiving element" that is recited in Claim 11. This objection is rendered moot by the above amendments to Claim 11 which specify that the light-receiving element is formed in a "cylindrical shape". Accordingly, Applicant respectfully requests that the objection to the drawings be withdrawn.

The Title of the Invention Has Been Objected to as Being Not Descriptive

Applicant respectfully submits that the amended title renders this objection moot.

Claim Objections

Claim 5 was objected to since the phrase "the semiconductor chip" allegedly lacks proper antecedent basis. Applicant respectfully submits that the above amendments to Claim 5 render this objection moot since Claim 5 now recites, in part, that "at least one of the semiconductor chips".

Claim 6 was objected to, since the phrase "the signal" lacks proper antecedent basis. In response, Applicant has amended each of the recitations of "the signal" to read "the optical signal". Accordingly, this objection to Claim 6 is also rendered moot.

Applicant respectfully requests that the objections to Claims 5 and 6 be withdrawn.

Claim Rejections Under 35 U.S.C. § 112, Second Paragraph

Claim 5 was rejected under 35 U.S.C. § 112, second paragraph as being indefinite. Regarding Claim 5, the Examiner asserts that, "it is unclear in its given context how one optical signal is transferred among a plurality of semiconductor chips when only one light-receiving element and one optical transfer device is claimed."

Applicant respectfully disagrees, and points the Examiner to the paragraph bridging pages 9 and 10 of the present Application. As noted therein, "Glass fibers 62 as an optical signal transfer device are connected in a lattice structure and embedded in the system substrate 61. ... the signal can be propagated through the entire area of the glass fibers 62."

Applicant respectfully submits that, based on, for example, the above-quoted text, as well as Fig. 4 of the present Application, that it is very clear how one optical signal can be transferred among a plurality of semiconductor chips.

Accordingly, Applicant respectfully requests that the rejection under 35 U.S.C. § 112, second paragraph be withdrawn.

Art-Based Rejections

Claims 4 and 8

Claim 4 was rejected under 35 U.S.C. § 102(b) as being anticipated by Reid et al. (U.S. Patent 5,009,476) or, alternatively, as being anticipated by Horwitz et al. (U.S. Patent 5,371,822). Claim 6 was rejected under 35 U.S.C. § 102(b) as being anticipated by either Reid et al. or Soichi (JP Publication 07-131063).

Applicant cancels Claims 1 and, and rewrites Claims 4 and 8 in independent form, respectively. To the extent the rejections based on Reid or Horowitz are applied to amended Claim 4, Applicant respectfully submits that amended independent Claims 4 and 8 are patentable over the Reid, Horwitz, and Soichi references.

For example, the Reid patent fails to teach or suggest "an optical signal transfer device embedded in the mounting substrate, wherein the optical signal transfer device directly contacts the light-receiving element for transferring the optical signal into the semiconductor chip", as recited in Claim 4. As is clearly shown in Fig. 3 of the Reid patent, the optic fiber channel 5 does not directly contact to the light-responsive device 11. This is further illustrated in Fig. 4 of Reid, which illustrates that the optical link is not directly connected to the phototransistor (RX) RX. As discussed at column 3, lines 6 through 15 of the Reid patent, "as shown in FIG. 3 ... an input element 11, ... is coupled to an optic fiber channel 5." Applicant respectfully submits that there is nothing that suggests that the input element 11 is directly conntacts the optic fiber channel 5. Moreover, Reid also fails to teach or suggest "an optical signal transfer device embedded in the mounting substrate", as recited in amended Claim 4.

Horwitz also fails to teach or suggest recitations of Claim 4 noted above. As shown in Fig. 2 of Horwitz, the optical fiber 30 clearly does not directly contact the optical emitter/receiver 28 as Fig. 2 clearly illustrates that there is a gap between those two elements. Moreover, the optical fibers 30 are not embedded in the semiconductor die 26, but are instead superposed above the die 26 and held in place by a package lid 16.

Thus, Applicant respectfully submits that the cited references fail to teach or suggest recitations of amended Claim 4. Accordingly, Claim 4 is not anticipated by either the Reid or Horwitz patents, and a rejection under § 102(b) should be withdrawn. Moreover, Claims 2 and 3 depend from Claim 4 and would be allowable at least by virtue of their dependency from Claim 4.

For at least the same reasons stated above with respect to independent Claim 4, Applicant respectfully submits that independent Claim 8 is patentable over the Reid reference. Moreover, the Soichi reference also fails to teach or suggest these recitations of Claim 8 that are missing from Reid. Accordingly, Applicant respectfully submits that amended independent Claim 8 is also patentable over both the Reid et al. and Soichi references.

Claim 3

Claim 3 was rejected under 35 U.S.C. § 102(b) as being anticipated by the Horwitz reference.

Applicant respectfully submits that the Horwitz reference fails to teach or suggest recitations of amended Claim 3, such as “a package that is in contact with and that seals the semiconductor chip”. As shown in Fig. 2 of the Horwitz reference, the package lid 16 covers a die cavity 14A in which the die 26 is placed. However, there is no teaching or suggestion of “a package that is in contact with and that seals the semiconductor chip” as recited in amended Claim 3. Since the Horwitz reference fails to teach or suggest each recitation of amended Claim 3, Applicant respectfully submits that the rejection of Claim 3 under § 102(b) is improper and should be withdrawn.

Claim 5

Claim 5 was rejected under 35 U.S.C. § 102(b) as being anticipated by the Reid reference.

As indicated above, the Reid reference fails to teach or suggest “at least one optical signal transfer device embedded in the mounting substrate”, as recited in amended Claim 5. As

indicated above, the Reid reference fails to teach or suggest "a light-receiving element ... that directly contacts the optical signal transfer device", as recited in amended Claim 5.

Moreover, Applicant respectfully submits that the cited references fail to teach or suggest recitations such as "the optical signal is transferred among the plurality of semiconductor chips through the optical signal transfer device", as recited in amended Claim 5. There is nothing shown in Figs. 3 and 4 of the Reid patent indicating that an individual or single optical signal can be transferred among a plurality of the chips 3, as recited in Claim 5.

Accordingly, Applicant respectfully submits that amended Claim 5 is patentable over the Reid reference.

Claim 9

Claim 9 was rejected under 35 U.S.C. § 102(b) as being anticipated by Soichi. Claim 9 has been rewritten in independent form.

Applicant respectfully submits that the Soichi reference fails to teach or suggest that "the optical signal transfer device is a light-emitting surface that is in the mounting substrate", as recited in Claim 9. Applicant respectfully submits that Fig. 1 of the Soichi reference fails to teach or suggest that the optical signal transfer device is a light-emitting surface, not to mention a light-emitting surface that is formed in the mounting substrate. Accordingly, Applicant respectfully submits that independent Claim 9 is separately patentable over the cited Soichi reference, and respectfully requests that this rejection be withdrawn.

Claim 10

Claim 10 was rejected under 35 U.S.C. § 102(b) as being anticipated by the Reid et al. reference. Claim 10 has been rewritten in independent form.

However, Applicant respectfully submits that the Reid reference fails to teach or suggest recitations of amended dependent Claim 10, such as "the optical signal transfer device is formed in a lattice configuration and embedded in the mounting substrate." Applicant respectfully submits that there is nothing in the Reid reference that teaches or suggests that the optical signal transfer devices are formed in a lattice configuration, much less that they are embedded in the mounting substrate. Moreover, the Reid reference also fails to teach or suggest that "the optical signal is transferred among the plurality of semiconductor chips through the optical signal transfer device", as recited in amended Claim 5. There is nothing shown in Figs. 3 and 4 of the Reid patent

indicating that an individual or single optical signal can be transferred among a plurality of the chips 3, as recited in Claim 5.

Accordingly, Applicant respectfully submits that independent Claim 10 is patentable over the Reid et al. patent, and requests that the rejection of dependent Claim 10 be withdrawn.

Claim 11

Dependent Claim 11, which depends from Claim 8, was rejected under 35 U.S.C. § 103(a) as being unpatentable over either one of Reid et al. or Soichi.

In rejecting Claim 11, the Examiner concedes that Reid et al. and Soichi "do not specifically disclose the shape of the light-receiving element and the insertion configuration as claimed." However, the Examiner concludes that these recitations are well known. Applicant agrees that the Reid et al. and Soichi references fail to teach or suggest recitations of Claim 11. For example, the Reid et al. and Soichi references fail to teach or suggest recitations of Claim 11 such as "the light-receiving element is inserted in the optical signal transfer device", as recited in dependent Claim 11. Accordingly, Applicant respectfully submits that independent Claim 11 is patentable over the Reid et al. and Soichi references.

In the event the Examiner seeks to maintain his rejection of Claim 11 based on the cited references, then Applicant respectfully requests that the Examiner provide a reference that teaches or suggests each of the recitations of Claim 11.

New dependent Claim 12

New dependent Claim 12 is also separately patentable over the cited references, as the cited references fail to teach or suggest that "a plurality of selected ones of said optical signal transfer devices extend in a first direction, and wherein a plurality of selected others of said optical signal transfer devices extend in a second direction different than said first direction and intersect the plurality of selected ones of said optical signal transfer devices", as recited in new dependent Claim 12. Accordingly, Applicant respectfully submits that new dependent Claim 12 is patentable over the cited references.

Accordingly, pending Claims 2-5 and 7-16 distinguish over the cited references, and are in condition for allowance. Reexamination and reconsideration of the Application, as amended, are requested.

If for any reason the Examiner finds the Application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number, (213) 337-6793 to discuss the steps necessary for placing the Application in condition for allowance.

If there are any fees due in connection with the filing of this response, then please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,
HOGAN & HARTSON L.L.P.

Date: June 18, 2002

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Version with markings to show changes made:

IN THE TITLE:

Please change the title to --SEMICONDUCTOR DEVICE INCLUDING A
LIGHT-RECEIVING ELEMENT--.

IN THE SPECIFICATION:

Please amend the specification as follows:

Please change the first heading at page 1, line 2 to read as follows: ✓

BACKGROUND OF THE INVENTION

Please delete the second heading at page 1, line 6 in its entirety:

Please change the third heading at page 2, line 19 to read as follows: ✓

SUMMARY OF THE PREFERRED EMBODIMENTS

At Page 1, line 2 delete "Field of Industrial Utility" and replace with -- BACKGROUND ✓
OF THE INVENTION --

At page 1, line 6, please delete "Prior Art".

At Page 2, line 19, please delete "SUMMARY OF THE INVENION" and replace with --
SUMMARY OF THE PREFERRED EMBODIMENTS --

At Page 5, line 14, please delete "OF THE PRESENT INVENTION".

IN THE CLAIMS:

Please cancel claims 1 and 6.

Please amend Claims 2-5 and 8-11 as follows:

2. (Amended) A semiconductor device according to claim [1] 4, wherein the optical signal transfer device is an optical fiber.

3. (Amended) A semiconductor device according to claim [2] 4, further comprising a package that is in contact with and that seals the semiconductor chip and a part of the optical fiber.

4. (Amended) A semiconductor device [according to claim 1, wherein the] comprising:
a semiconductor chip [is] mounted on a mounting substrate and a light-receiving element formed in the semiconductor chip for receiving an optical signal; and
an optical signal transfer device embedded in the mounting substrate, wherein the optical signal transfer device directly contacts the light-receiving element for transferring the optical signal into the semiconductor chip.

5. (Amended) A semiconductor device comprising:
a mounting substrate and [an] at least one optical signal transfer device [disposed] embedded in the mounting substrate for transferring an optical signal;
a plurality of semiconductor chips mounted on the mounting substrate; and
a light-receiving element formed in at least one of the semiconductor [chip] chips and that directly contacts [connected to] the optical signal transfer device for receiving the optical signal,
wherein the optical signal is transferred among the plurality of semiconductor chips through the optical signal transfer device.

Please cancel Claim 6.

8. (Amended) A semiconductor device [according to claim 6], comprising:
a semiconductor chip and a light-receiving element formed on the semiconductor chip for receiving an optical signal, wherein the semiconductor chip is disposed in a first plane; and

an optical signal transfer device [connected to] that directly contacts the light-receiving element for transferring the optical signal from an arithmetic processing apparatus [as an optical signal] into the semiconductor chip, wherein the optical signal transfer device is disposed in a second plane that is spaced apart from the first plane,

wherein the optical signal transfer device is [provided] embedded in a mounting substrate on which the semiconductor chip is mounted.

9. (Amended) A semiconductor device [according to claim 6,] comprising:
a semiconductor chip and a light-receiving element formed on the semiconductor chip for receiving an optical signal; and
an optical signal transfer device connected to the light-receiving element for transferring the optical signal from an arithmetic processing apparatus as an optical signal into the semiconductor chip, wherein the optical signal transfer device is a light-emitting surface that is formed in the mounting substrate.

10. (Amended) A semiconductor device [according to claim 6], comprising:
a mounting substrate;
at least one optical signal transfer device embedded in the mounting substrate, wherein the at least one optical signal transfer device is adapted to transfer an optical signal;
a plurality of semiconductor chips mounted on the mounting substrate; and
a light-receiving element formed in at least one of the semiconductor chips and that is connected to the optical signal transfer device for receiving the optical signal,
wherein the optical signal is transferred among the plurality of semiconductor chips through the optical signal transfer device, wherein the optical signal transfer device is formed in a lattice configuration and [disposed] embedded in the mounting substrate.

11. (Amended) A semiconductor device according to claim 8, wherein the light-receiving element is formed in a [convex] cylindrical shape on the semiconductor chip on a side thereof that is opposite to the mounting substrate, and the light-receiving element is inserted in the optical signal transfer device to thereby connect the light-receiving element to the optical signal transfer device.

Please add new Claims 12-16 as follows:

12. (New) A semiconductor device according to Claim 10, wherein a plurality of selected ones of said optical signal transfer devices extend in a first direction, and wherein a plurality of selected others of said optical signal transfer devices extend in a second direction different than the first direction and intersect the plurality of selected ones of said optical signal transfer devices.

13. (New) A semiconductor device comprising:
a mounting substrate and at least one optical signal transfer device disposed in a first plane in the mounting substrate for transferring an optical signal;
a plurality of semiconductor chips mounted on the mounting substrate, wherein the semiconductor chips are disposed in a second plane that is spaced apart from the first plane; and
a light-receiving element formed in at least one of the semiconductor chips and that directly contacts the optical signal transfer device for receiving the optical signal,
wherein the optical signal is transferred among the plurality of semiconductor chips through the optical signal transfer device.

14. (New) A semiconductor device according to claim 9, wherein the light-receiving element is formed in a cylindrical shape on the semiconductor chip on a side thereof that is opposite to the mounting substrate, and the light-receiving element is inserted in the optical signal transfer device to thereby connect the light-receiving element to the optical signal transfer device.

15. (New) A semiconductor device according to claim 10, wherein the light-receiving element is formed in a cylindrical shape on the semiconductor chip on a side thereof that is opposite to the mounting substrate, and the light-receiving element is inserted in the optical signal transfer device to thereby connect the light-receiving element to the optical signal transfer device.

16. (New) A semiconductor device comprising:
a semiconductor chip and a light-receiving element formed in the semiconductor chip for receiving an optical signal, wherein the semiconductor chip is disposed in a first plane; and
an optical signal transfer device connected to the light-receiving element for transferring the optical signal into the semiconductor chip,

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wherein the optical signal transfer device is disposed in a second plane that is spaced apart from the first plane.